APPENDIX D. DRAFT STAGE 1 ACTIONS

This chapter describes at a programmatic level of detail the draft list of priority ERP actions that will be implemented in the first 7 years of the CALFED program. The draft Stage 1 actions describe:

- the critical processes, habitats and species that will be addressed for key tributary watersheds,
- the rationale for the selection of actions to be implemented during Stage 1,
- actions already being implemented as part of CALFED's Restoration Coordination Program, CVPIA, or other restoration programs, and
- uncertainties about ecosystem structure and function that can be answered by designing restoration actions to maximize their information value.

DRAFT SACRAMENTO-SAN JOAQUIN DELTA STAGE 1 ACTIONS

DESCRIPTION OF THE SACRAMENTO-SAN JOAQUIN DELTA REGION

The Sacramento-San Joaquin River Delta (Delta) is the tidal confluence of the Sacramento and San Joaquin rivers. Once a vast maze of interconnected wetlands, ponds, sloughs, channels, marshes, and extensive riparian strips it is now islands of reclaimed farmland protected from flooding by hundreds of miles of levees. Remnants of the tule marshes are found on small "channel" islands or shorelines of remaining sloughs and channels.

Despite many changes, the Delta remains a productive region for many species of native and non-native fish, waterfowl, shorebirds, and wildlife. All anadromous fish of the Central Valley migrate through the Delta or spawn in, rear in, or are dependent on the Delta for some critical part of their life cycle. Native resident fish including delta smelt and splittail spend most of their lives within the Delta. Many of the Pacific Flyway's waterfowl and shorebirds pass through or winter in the Delta. Many migratory songbirds and raptors migrate through the Delta or depend on it for nesting or wintering habitat. Considerable areas of waterfowl and wildlife habitat occur along the channels and sloughs and within the leveed agricultural lands. The Delta also supports many plants with restricted distribution and some important plant communities.

Factors having the greatest influence on Delta ecological health include:

1. Hydrologic regime altered by reduced inflow, reduced seasonal and inter-annual hydrologic variability and large in-Delta diversions;
2. Hydraulics and hydrodynamics altered by leveed islands, channel dredging, and south Delta pumping;
3. Food web altered by introduced species, reduced inputs of organic carbon and decreased residence time of water and organisms;
4. Conversion of agricultural land (which provides surrogate habitat for many avian species) to low habitat value crops or to urban development.
5. Tidal marsh and riparian habitats lost to island reclamation to agriculture, levee construction and maintenance (rip-rapping), wave and boat wake erosion;
6. Water quality degraded from industrial, agricultural and residential pollutants;
7. Elevated water temperatures; and
8. Entrainment of fishes in power plants and south Delta State and Federal diversions.

STAGE 1 APPROACH

Stage 1 actions in the Delta have been selected to address the following key issues (described earlier in Chapter 5):

- The impact of introduced species and the degree to which they may pose a significant threat to reaching restoration objectives.
- Development of an alternative approach to manage floods by allowing river access to more of their natural floodplains and integrating ecosystem restoration activities with the Comprehensive Study.
- Increasing the ecological benefits from existing flood bypasses, such as the Yolo Bypass, so that they provide improved habitat for waterfowl, fish spawning and rearing, and possibly as a source of food and nutrients for the estuarine foodwebs.
- Thoroughly testing the assumptions that shallow water tidal and freshwater marsh habitats are limiting the fish and wildlife populations of interest in the Delta.
- The need to better understand the underlying mechanisms of the X2 salinity standard in the Delta and the resultant effects on aquatic organisms.
- The need to better understand the linkage between the decline at the base of the estuarine foodweb and the accompanying decline of some higher level species and trophic groups.
- Clarify the extent to which entrainment at the CVP and SWP pumping plants affects population sizes of fish and invertebrate species; and
- Clarifying the suitability and use of the Delta for rearing by juvenile salmon and steelhead.

The proposed Stage 1 approach for the Sacramento-San Joaquin Delta is to broadly design and implement actions that will make a substantial contribution to developing aquatic and terrestrial habitat through the Delta which connect with upstream areas. In addition to the focus on the corridor concept, a variety of general actions will be implemented, ranging from large-scale tidal marsh restoration and research projects (Frank's Tract, Little Holland Tract and Liberty and Prospect islands), floodplain restoration, and control and eradication of introduced species. Implementation of these actions and linking them through adaptive management to the Comprehensive Monitoring, Assessment and Research Program will be major steps toward resolving the important Stage 1 issues and will set the direction for subsequent implementation stages.

The three major habitat corridors envisioned include the following:

- **THE NORTH DELTA HABITAT CORRIDOR** will provide a contiguous habitat corridor connecting the mosaic of tidal marsh, seasonal floodplain, riparian and perennial grassland habitats in the Yolo Bypass, Cache Slough Complex, Prospect Island, Little Holland Tract, Liberty Island and Steamboat Slough.
- **THE EAST DELTA HABITAT CORRIDOR** will restore a large, contiguous corridor containing a mosaic of habitat types including tidal perennial aquatic, riparian and riverine aquatic habitat, essential fish habitat, and improved floodplain-stream channel interactions. The focus area includes the South Fork of the Mokelumne River, East Delta dead-end sloughs, Georgiana Slough, Snodgrass Slough, and the Cosumnes River.
- **THE SAN JOAQUIN RIVER HABITAT CORRIDOR** will provide a contiguous habitat corridor of tidal perennial aquatic habitat, freshwater fish habitat, essential fish habitat and improved river-floodplain interactions.

NORTH DELTA HABITAT CORRIDOR STAGE 1 ACTIONS

Major features of the North Delta are the Yolo Bypass, the Sacramento Deep Water Ship Channel, the Sacramento River downstream of Sacramento to Rio Vista, and sloughs connecting the Sacramento River to the Cache Slough complex at the base of the Yolo bypass.

The Stage 1 proposal for the North Delta is to restore a large, contiguous habitat corridor connecting a mosaic of tidal marsh, seasonal floodplain, riparian, and upland grassland habitats. This involves:

- Increasing the quantity and quality of seasonal and perennial wetlands,
- Improving flows, riparian and seasonal wetlands and fish passage in the Yolo Bypass,
- Restoring Prospect Island to tidal and seasonal wetlands to connect with the Cache Slough complex,
- Restoring Little Holland Tract to tidal wetlands to connect with the Cache Slough complex,
- Restoring Liberty Island to tidal and seasonal wetlands to connect with the Cache Slough complex, and
- Protection and enhancement of riparian habitat in Steamboat Slough.

These actions are a high priority because there is the potential to effectively restore and connect multiple habitat types into a functional habitat corridor. The habitat corridor will improve an important rearing, migration, and spawning area for anadromous and resident fishes as well as important habitat for waterfowl, special-status plants, reptiles, and other species. This suite of actions provides a unique opportunity to restore the only functional floodplain ecosystem in the Delta at a large scale, low cost, and with high information and learning potential. Restoration at this location offers the ability to address major restoration issues and uncertainties including:

- Evaluation of species utilization of flood bypasses,
- Ability to control introduced aquatic and riparian plants,
- Evaluation of mercury methylization potential,
- Experimentation of tidal marsh restoration techniques, and
- Experimentation of the relationship between variable salinity regimes, physical habitat and species.

The Restoration Coordination Program has funded many projects that are critical to restoring this habitat corridor and may fund additional projects during 1999. Before major actions are taken in Stage 1, the results of the previously funded projects will be assessed and the proposed Stage 1 actions may be refined accordingly. Many of the projects listed below will require planning studies and outreach to local landowners, recreation interests, and coordination with other agency and CALFED Program activities.

The proposal for the Yolo Bypass is to coordinate planning with the Yolo Bypass foundation to restore permanent flows, fish passage, and seasonal wetland habitat consistent with flood management requirements. The Yolo Bypass is a managed floodway that provides extremely important habitat when flooded for splittail spawning and salmon rearing. When not flooded, the Yolo Basin wetlands provide critical habitat along the Pacific Flyway for tens of thousands of migratory waterfowl and wading birds. This habitat could be enhanced at a low-cost and large scale because restoration will not have significant impacts to existing agricultural practices, bypass land is either publicly owned or privately owned land with flood easements, and restoration actions can be bundled with flood control improvements. There is an unknown, potential benefit by improving salmon passage through the major Bypass slough, the Tule Canal/Toe Drain, to connect with the Sacramento River and Cache Creek.

Potential restoration actions in the Yolo Bypass must be modeled for potential flood control impacts and will only go forward if compatible with flood control requirements or if the impacts are mitigated. For example, the increased channel roughness caused by new riparian habitat in Tule Canal/Toe will have to be offset by increased flood capacity.

ACTION 1: Increase the duration of Yolo Bypass flooding in winter and spring by modifying the Fremont Weir to allow lower-stage flows of the Sacramento River to pass through the Yolo Bypass.

- Install an inflatable barrier to induce overbank flooding out of the Tule Canal/Toe Drain or modify the Tule Canal/Toe Drain as described in Action 3 to create an excavated, shallow flooded region.

RATIONALE: Before the Yolo Basin was developed as a flood bypass system, flow from the Sacramento River entered the basin at much lower flows than the Fremont Weir currently allows to reduce flood risk associated with the Sacramento and American rivers; consequently, the Bypass only receives flow from the Sacramento River during very high flow events.

Floodplains, and in particular the Yolo Bypass, are seasonally important habitats for native fishes including splittail and chinook salmon and may provide a large source of food and nutrients for the estuarine food web. The beneficial impacts of bypass flooding can be increased without sacrificing flood control capabilities and not interfering with agricultural practices. Lowering the height of a portion of the Fremont Weir (and possibly the Sacramento Weir) would allow lower-stage Sacramento River flows in winter and spring to flood a portion of the Bypass. Because the basin slopes toward the East, additional flows may simply concentrate in the Tule Canal/Toe Drain rather than inundate the floodplain. To increase the extent of floodplain inundation, an inflatable barrier can be installed at the base of the Toe Drain channel to induce overbank flooding. Increased flood duration would also improve fish passage to Cache and Putah creeks.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Evaluate use of inflatable barrier to induce overbank flooding of the Tule Canal/Toe Drain.
- Study invasion of exotic plants such as Arundo and tamarisk. Develop control measures.
- Evaluate potential for mercury methylization potential (from Cache Creek).
- Evaluate potential flood control impacts and mitigation alternatives.
- Value for splittail spawning.
- Value of improved chinook salmon survival.
- Contribution to total organic carbon and phytoplankton growth.
- Potential adverse effects of total organic carbon on drinking water supplies.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

The Yolo Basin Foundation recently completed wetland restoration in the Yolo Bypass that is now being managed by the Department of Fish and Game. CALFED FY 98 Restoration Coordination Program funds were provided for Lower Putah Creek watershed planning and Yolo Bypass restoration planning.

CALFED FY 97 Restoration Coordination Program funds were provided for an assessment of the capacity of different Delta habitats to support the nutritional requirements of the invertebrate biota that sustain upper trophic level organisms. FY 97 funds were also provided to evaluate the potential of mercury methylization produced through wetland restoration.

ACTION 2: Construct a fish ladder at Fremont Weir to provide for fish passage through the Tule Canal/Toe Drain to the Sacramento River.

RATIONALE: Improved flows through the Bypass will attract adult anadromous fish that must navigate past the weir to reach their natal spawning habitat on the upper Sacramento River. Providing passage around the Fremont Weir will help prevent migratory fish from being stranded.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- The ladder must be evaluated for effectiveness of adult and juvenile fish passage including white sturgeon, green sturgeon, American shad, striped bass and lamprey.

ACTION 3: Evaluate the feasibility and benefits of widening the Tule Canal/Toe Drain channel, restoring riparian vegetation and improving year-round flows. Potential actions include:

- Excavate a wider channel to convey winter and spring flows from the Fremont Weir;
- Allocate water to sustain higher summer and fall flows (non-flood) through the Tule Canal/Toe Drain;
- Better connect the channel by enlarging existing culverts, etc. to allow fish passage at low flows;
- Construct new channels connecting the Tule Canal/Toe Drain with Putah Creek, Cache Creek and the Fremont Weir fish ladder; and
- Restore riparian habitat along the Tule Canal/Toe Drain, including on the Sacramento Ship Channel levee.

RATIONALE: The Tule Canal/Toe Drain is a slough along the east side of the Bypass (the slough is referred to as "Tule Canal" from the Fremont Weir to the Yolo Causeway and as the "Toe Drain" from the causeway to Cache Slough). During most of the year when the bypass is not flooded, the Tule Canal/Toe Drain does not provide migratory fishes access to Putah Creek, Cache Creek and the Sacramento River. However, when the bypass is flooded, fish can migrate through the Bypass to Cache and Putah creeks and the Sacramento River. In 1997 and 1998, adult chinook salmon spawned in Putah Creek. Outmigration of juveniles from Putah Creek may be impeded or impossible in the absence of better-connected channels to the Toe Drain.

Tule Canal/Toe Drain channel improvements and restored riparian, in conjunction with increased winter and spring flows from Action 1 and a fish ladder at Fremont Weir from Action 2, will enable year-round fish passage and longer-duration seasonal floodplain habitat.

It may also be beneficial to improve summer and fall flows through the Bypass to allow for fish passage to Cache and Putah Creeks and the Sacramento River. It may also serve as a better migration corridor than the Sacramento River for migratory fishes. If it is determined that additional flow would primarily benefit non-native fishes, this action will not be implemented.

ADAPTIVE MANAGEMENT CONSIDERATIONS: Evaluate native and non-native species utilization of the bypass.

ACTION 4: Evaluate potential flood conveyance impacts from actions 1 to 3. Conduct a feasibility analysis to increase flood flow capacity in the Yolo Bypass to compensate for lost flood capacity from Bypass restoration.

- Enlarging the openings of the railroad causeway may be an alternative to increase capacity.

RATIONALE: Restored riparian habitat in Tule Canal/Toe Drain will increase the roughness of the Bypass, reducing its flood conveyance capacity. The railroad causeway restricts the flow of floodwaters through the Bypass and also creates conditions that tend to strand larval, juvenile, and occasionally adult fish when the water recedes. The small openings through the railroad causeway can be enlarged to increase net flood capacity of the Bypass and reduce stranding effects.

ACTION 5: Conduct a feasibility analysis of opportunities to reduce fish stranding in the Bypass. Refine Actions 1, 3 and 4 accordingly.

RATIONALE: The Bypass tends to drain quickly after flooding, potentially stranding a significant number of salmon, Delta smelt and other fishes. Fish stranding can be reduced by creating new channels through ponded areas to improve drainage to the Tule Canal/Toe Drain and by re-grading land to provide better connectivity with distributary sloughs.

TARGETED RESEARCH: Evaluate conditions favorable to splittail spawning (wetted perimeter, depth, timing, and duration).

RATIONALE: Splittail are known to use the Bypass and other flooded seasonal habitats to spawn, but the optimal spawning conditions are unknown. By studying spawning behavior and habitat preferences in different water year floods, the knowledge gained may be used to better manage Bypass flows to benefit splittail.

The Department of Water Resources has been conducting these types in the Yolo Bypass. These studies need to continue and include the development of conceptual models.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Through Action 1, vary flow rates from Fremont Weir to study splittail spawning.

ACTION 6: Plan and implement restoration of shallow water habitat on Little Holland Tract.

ACTION 7: Plan and implement restoration of shallow water habitat and seasonal wetlands on Prospect Island.

ACTION 8: Plan and implement restoration of shallow water habitat and seasonal wetlands on Liberty Island.

ACTION 9: Plan and implement restoration of shallow water habitat in the lower Yolo Bypass.

RATIONALE: Prospect, Liberty, and Little Holland are ideal locations to restore tidal marshes. Most of the land is or will soon be publicly owned, therefore it will reduce the need to convert additional agricultural land to habitat. Since they are located at the outlet of the Yolo Bypass, they are more susceptible to flooding. The islands are not as subsided as other Delta islands, so they will require less effort to construct suitable land elevations for habitat. Restoration can build upon existing tidal marsh habitat on the margins of these islands. Tidal marsh restored on these islands will connect with the important riparian and seasonal floodplain habitats in the Yolo Bypass, tidal marsh and riparian habitats in the Cache Slough complex, Steamboat Slough, and the Sacramento River.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Evaluate multiple tidal marsh restoration techniques.
- Evaluate species colonization and succession.
- Study native vs. non-native species use of shallow-water habitats.
- Develop control measures for non-native aquatic plants.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

CALFED FY 97 and 98 Restoration Coordination Program funds were provided for acquisition and restoration of Prospect Island, acquisition of Liberty Island, restoration of SRA, tidal slough habitat, and perennial grasslands along/adjacent to Barker Slough and Calhoun Cut, restoration of SRA habitat along a Cache Slough levee, and relocation and screening of diversions on Hastings Tract to reduce the entrainment of delta smelt.

Category III funds were provided for a North Delta salmon rearing study.

PILOT PROJECT/TARGETED RESEARCH: Develop a plan to design and evaluate tidal marsh restoration of Prospect, Liberty and Little Holland in the North Delta. Study the relationship between salinity gradients, salinity variability, and physical habitat and the effect on species in the tidal North Delta.

- Modify physical habitat configurations to vary salinity gradients and evaluate effects on species.

RATIONALE: Restoration in the North Delta provides an opportunity to learn about species utilization of shallow-water, tidal marsh habitats and salinity gradients. The seasonal and inter-annual variations in Delta inflow created a variable salinity regime. Construction of reservoirs, water diversions, and modification of Delta islands have reduced the variability of flow and salinity conditions. Native plant, wildlife and fish species evolved with the variable flow and salinity regimes. Reducing the variability may have provided competitive advantage to non-native species. Developing a plan to experiment with flows and salinity gradients may identify conditions that benefit native species.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Extent to which physical habitat may be limiting native and introduced species.
- How salinity gradients and variability affect conditions and species in shallow-water habitats.

- Calibration of models to evaluate changes in Delta hydraulics resulting from wetland restoration.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

CALFED FY 97 funds were provided for a Delta sediment transport and availability study.

Category III funds were provided for a North Delta salmon rearing study.

ACTION 10: Develop and implement measures to rehabilitate and restore a riparian and shaded riverine aquatic habitat corridor along Steamboat Slough.

RATIONALE: Steamboat Slough is an important migratory corridor for Sacramento River salmon. Habitat conditions are more favorable in Steamboat than the Sacramento River, and there is little opportunity to restore riparian habitat on the large, federal levees of the Sacramento River. Attempts should be made to protect existing habitat from boat wakes and other activities associated with heavy recreational use on Steamboat Slough. Existing boat speed restrictions have not been effective in stopping degradation of existing habitat.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Evaluate Sacramento salmon smolt survival through Coded Wire Tag (CWT) (paired) experiments to assess baseline survival and survival after restoration.

EAST DELTA HABITAT CORRIDOR STAGE 1 ACTIONS

Major features of the East Delta are the North and South Forks of the Mokelumne River, the Cosumnes River and floodplain, dead-end sloughs adjoining the South Fork, and Georgina Slough. For purposes of Stage 1 action grouping, Snodgrass Slough of the North Delta region is considered a functional unit of this habitat corridor. The East Delta is an important region for its diversity of plant, fish and avian species, and a functioning floodplain on the Cosumnes River.

The objective for the East Delta is to restore a large, contiguous corridor containing a mosaic of habitat types. Restoration in the East Delta offers the best opportunity to evaluate and restore natural ecological functions in the Delta. Stage 1 actions will focus on tidal marsh and riparian habitat restoration on the South Fork of the Mokelumne River, East Delta dead-end sloughs, Georgiana Slough, Snodgrass Slough and the Cosumnes River floodplain.

ACTION 1: Restore and rehabilitate a contiguous corridor of riparian, shaded riverine aquatic, tidal freshwater, and seasonal and perennial habitats along the South Fork of the Mokelumne River.

RATIONALE: Restoration of this corridor may improve rearing and migration of salmon from the Mokelumne and Cosumnes rivers. It is an opportunity to restore critical ecological processes including flood processes. Land elevations are suitable for tidal marsh and riparian restoration.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Evaluate the benefits of large-scale restoration of ecological processes on the Mokelumne.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

CALFED FY 97 and 98 Restoration Coordination Program funds were provided for acquisition of property along the lower Cosumnes River floodplain, community-based planning for the lower Mokelumne River watershed, construction of a 3.4 mile long, 400 foot levee setback on the Mokelumne River, and fish passage and fish screen improvements at Woodbridge Dam. FY 98 funds are being used to acquire McCormack-Williamson Tract

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ACTION 2: Restore tidal marsh and riparian habitats on McCormack-Williamson Tract in conjunction with other flood control measures.

RATIONALE: McCormack-Williamson, a highly flood-prone tract, is planned to be acquired in FY 99. Breaching McCormack-Williamson levees and restoring the tract to tidal marsh and riparian habitat in conjunction with other flood control

efforts can relieve flooding pressure in the North Delta and improve habitat connectivity with the Cosumnes River floodplain. The tract is ideal for restoration to tidal and riparian habitats due to favorable land elevations.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Evaluate species colonization and succession.
- Evaluate the effects of natural process restoration on the evolution of riparian and tidal marsh habitats.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

CALFED FY 97 Restoration Coordination Program funds were provided for acquisition and planning for restoration of 4,600 acres of property adjacent to the Cosumnes River and FY 98 funds are being used to acquire McCormack-Williamson Tract.

Sacramento County Flood Control Agency (SAFCA) and North Delta Flood Management will be consulted with on restoration efforts.

ACTION 3: Restore tidal marsh and riparian habitats on Georgiana Slough.

RATIONALE: Georgiana Slough is a major migration corridor for salmon. Substantial losses to salmon may occur due to predation and entrainment in the slough.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Evaluate benefits of restoring additional habitats in areas of high predation and entrainment

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

CALFED FY 97 Restoration Coordination Program funds were provided for restoration of SRA and riparian habitat along 2,000 ft of Georgiana Slough and 3,000 ft along the North Fork of the Mokelumne River on Tyler Island.

ACTION 4: Restore tidal marsh and riparian habitats on East Delta sloughs in conjunction with control of non-native aquatic plants.

RATIONALE: Backwater habitats are critical habitat for Delta native fishes. The dead-end sloughs tend to be clogged with non-native plants like water hyacinth. Restoration of riparian and wetland habitats will provide food and cover for native fishes. Restoration of these sloughs to benefit native fishes and plants must include eradication of non-native plants.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Evaluate native vs. non-native species use prior to and after restoration.

ACTION 5: Restore mid-channel islands and experiment with multiple techniques to allow natural sediment accretion to create new mid-channel islands and to protect mid-channel shallow-water habitat from boat wakes.

RATIONALE: Boat wakes and other stressors have significantly reduced the quantity and quality of mid-channel habitat. Multiple approaches should be used to protect existing mid-channel islands including limiting boat speeds in sensitive areas, installing wave attenuation structures, and also to encourage natural creation of islands.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Experiment with techniques to reduce erosion.
- Relationship to Delta sediment transport and depositional processes.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

CALFED FY 97 funds were provided for a Delta sediment transport and availability study and for an in-channel islands restoration demonstration project (Little Tinsley, Webb Tract 3, 10 and 21).

ACTION 6: Develop and implement incentives for wildlife-friendly agriculture on Staten Island.

RATIONALE: Agricultural fields provide surrogate habitat for resident and migratory wildlife. Incentives could include not harvesting crop to improve forage value for wildlife or changing

cropping patterns.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Monitor the use of lands in the incentive program by waterfowl and other species.
- Prepare an economic analysis of the most cost-effective means to fully support the agricultural industry while increasing the value for wildlife.
- Evaluate the relationship of bioenergetics and nutrients to migratory species

SAN JOAQUIN RIVER HABITAT CORRIDOR STAGE 1 ACTIONS

The San Joaquin is an important region for many native fishes including delta smelt, splittail and salmonids. Little shallow-water and riparian habitat remains on the San Joaquin River. The habitat that does remain in-channel and along levees is being degraded by wind and boat waves and levee maintenance. Water quality is poor for much of the year; there is low dissolved oxygen, high salinity, agricultural, residential and industrial contaminants, and water temperature is often elevated. Restoration opportunities are limited by the requirements of flood control, levee maintenance and dredging for ship navigation.

The Stage 1 proposal for the San Joaquin River is to restore a contiguous habitat corridor of tidal marsh, shaded riverine aquatic, riparian, and floodplain habitats. Reconnaissance studies should be initiated to evaluate opportunities for wetland and floodplain habitat in the river channel, on levees, on shallow levee berms, and for incorporation into the design of levee upgrades. CALFED Water Quality Program actions will also enhance the San Joaquin River restoration efforts in Stage 1.

ACTION 1: Conduct a feasibility study and, as appropriate, construct setback levees or shallow water berms along the San Joaquin River between Stockton and Mossdale where practicable to restore floodplain and riparian habitats and to increase channel capacity.

RATIONALE: Restoration of the San Joaquin River corridor can improve an important rearing and migration corridor for fishes and would provide information on our ability to reestablish floodplain processes in the Delta. There is the potential to utilize clean dredge material available from other areas in the Delta for in-channel restoration. As floodplains are restored splittail spawning and delta smelt and salmon usage will be evaluated.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Determine the feasibility of larger-scale restoration of riparian floodplain habitat and flood processes in the Delta.
- Evaluate species utilization of riparian and floodplain habitats, including benefits to splittail spawning and outmigrant San Joaquin salmon mortality.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

FY '97 Category III funds have been used to purchase fee title or easements on over 6,000 acres of land adjacent to the San Joaquin National Wildlife Refuge and have been used to help screen Banta-Carbona Irrigation District's diversion.

- Vernalis Adaptive Management Plan (VAMP)
- San Joaquin River Management Plan
- CALFED Levee Program
- Comprehensive Study

TARGETED RESEARCH: Evaluate species utilization of shallow-water wetlands on Venice Tip and McDonald Tip.

RATIONALE: Knowledge of the habitat preferences and utilization of shallow-water and floodplain habitats along the San Joaquin River by fish such as splittail (for spawning) and juvenile salmon (for rearing) is limited.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Determine San Joaquin River salmon smolt survival through Coded Wire Tag (CWT) (paired) experiments to assess baseline survival and the change in survival following restoration.

- Determine the residence time and rearing of San Joaquin River salmon, delta smelt, and other native species.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

CALFED FY 98 funds were provided for a study to identify the movement of adult chinook salmon in the lower Delta and lower San Joaquin River and evaluate the impacts of barrier operations and dissolved oxygen (DO) levels.

The DFG has conducted studies of chinook salmon smolt migration.

- VAMP

ACTION 2: Restore mid-channel islands and experiment with multiple techniques to allow natural sediment accretion to create new mid-channel islands and to protect mid-channel shallow-water habitat from boat wakes.

RATIONALE: Restoration of mid-channel islands may be the most effective means to improve habitat continuity along the San Joaquin. There is some existing mid-channel habitat (although diminished from boat wakes and channel modifications) that can be enhanced and a considerable amount of new habitat can be accommodated in the wide channel of the San Joaquin River. Existing mid-channel habitat can be augmented and new habitat created using Stockton Ship Channel dredge material and by encouraging natural sediment deposition.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Experiment with techniques to reduce erosion including the need to armor mid-channel islands.
- Relationship to Delta sediment transport and depositional processes.
- Identify species colonization and succession rates.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

CALFED FY 97 funds were provided for a Delta sediment transport and availability study and in-channel islands restoration demonstration projects (Little Tinsley, Webb Tract 3, 10 and 21).

- CALFED Levee Program

CENTRAL AND WEST DELTA STAGE 1 ACTIONS

Major features of the Central and West Delta are the flooded Frank's Tract and Big Break, the Sacramento and San Joaquin Rivers to Collinsville, and Delta islands, including many islands subsided over twenty feet in many places.

ACTION 1: Restore Frank's Tract to a mosaic of habitat types using clean dredge materials and natural sediment accretion. Control or eradicate introduced, nuisance aquatic plants.

RATIONALE: Frank's Tract is a flooded Delta island that can be restored to a mosaic of habitat types with no impact to agriculture. Frank's Tract levees were breached and the island has been flooded since the early 1900s. The deep bed of the island does not provide good quality habitat for native fish. Parts of the island bed could be elevated through a combination of dredge material placement, natural sediment accretion, and peat accumulation. Frank's Tract will be a functional component of the San Joaquin River corridor, a major fish rearing and migration area, as well as provide continuity with existing and proposed habitats in the western Delta. Developing the tract must also occur in conjunction with the control or eradication of introduced, nuisance aquatic plants for restoration to be most beneficial to native species.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Use multiple techniques to restore tidal habitats, including physical creation and natural sediment accretion.
- Use of dredge material to build wetlands.